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LIGATING CLIP WITH INTEGRAL CUTTING GUIDE

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Description

LIGATING CLIP WITH INTEGRAL CUTTING GUIDE

Technical Field

The present disclosure relates to surgical clips, and more particularly to ligating clips with integral cutting guides to facilitate properly cutting vessels and other tissue to be clamped by the surgical clip, such that a safe amount of tissue remains extending from the cutting side of the clip. Yet more particularly, the present disclosure relates to an improved surgical ligating clip that is provided with one or more cutting guides extending outward from and disposed along at least a length of one or more opposing side surfaces of the clip.

Background Art

Many surgical procedures require vessels or other tissues of the human body to be ligated during the surgical process. For example, many surgical procedures require cutting blood vessels (e.g., veins or arteries), and these blood vessels may require ligation to reduce bleeding. In some instances, a surgeon may wish to ligate the vessel temporarily to reduce blood flow to the surgical site during the surgical procedure. In other instances a surgeon may wish to permanently ligate a vessel. Ligation of vessels or other tissues can be performed by closing the vessel with a ligating clip, or by suturing the vessel with surgical thread. The use of surgical thread for ligation requires complex manipulations of the needle and suture material to form the knots required to secure the vessel. Such complex manipulations are time-consuming and difficult to perform, particularly in endoscopic surgical procedures, which are characterized by limited space and visibility. By contrast, ligating clips are relatively easy and quick to apply. Typically, a clip is applied to the vessel or

other tissue by using a dedicated mechanical instrument commonly referred to as a surgical clip applier, ligating clip applier, or hemostatic clip applier. Accordingly, the use of ligating clips in endoscopic as well as open surgical procedures has grown dramatically.

Ligating clips can be classified according to their geometric configuration (e.g., symmetric clips or asymmetric clips), and according to the material from which they are manufactured (e.g., metal clips or polymeric clips). Symmetric clips are generally "U" or "V" shaped and thus are substantially symmetrical about a central, longitudinal axis extending between the legs of the clip. Symmetric clips are usually constructed from metals such as stainless steel, titanium, tantalum, or alloys thereof. By means of a dedicated clip applier, the metal clip is permanently deformed over the vessel. An example of one such clip is disclosed in U.S. Patent No. 5,509,920 to Phillips et al. An example of a metallic clip applier is disclosed in U.S. Patent No. 3,326,216 to Wood in which a forceps-type applier having conformal jaws is used to grip and maintain alignment of the clip during deformation. Such appliers may additionally dispense a plurality of clips for sequential application, as disclosed in U.S. Patent No. 4,509,518 to McGarry et al.

With the advent of high technology diagnostic techniques using computer tomography (CATSCAN) and magnetic resonance imaging (MRI), metallic clips have been found to interfere with the imaging techniques. To overcome such interference limitations, biocompatible polymers have been increasingly used for surgical clips. Unlike metallic clips, which are usually symmetric, polymeric clips are usually asymmetric in design and hence lack an axis of symmetry. Inasmuch as the plastic clip cannot be permanently deformed for secure closure around a vessel or other tissue, latching mechanisms have been incorporated into the clip design to establish closure conditions and to secure against re-opening of the vessel. For example, well known polymeric clips are disclosed in U.S. Patent No. 4,834,096 to Oh et al. and U.S. Patent No. 5,062,846 to Oh et al., both of which are assigned to the assignee of the presently disclosed subject matter. These plastic clips generally comprise a pair of curved legs joined at their proximal ends with an

integral hinge or heel. The distal ends of the curved legs include interlocking latching members. For example, the distal end of one leg terminates in a lip or hook structure into which the distal end of the other leg securely fits to lock the clip in place.

The distal ends of the clips taught in U.S. Patent No. 5,062,846 to Oh et al. also include lateral bosses that are engaged by the jaws of a clip applier. A clip applier specifically designed for asymmetric plastic clips is used to close the clip around the tissue to be ligated, and to latch or lock the clip in the closed condition. In operation, the jaws of this clip applier are actuated into compressing contact with the legs of the clip. This causes the legs to pivot inwardly about the hinge, thereby deflecting the hook of the one leg to allow reception therein of the distal end of the other leg. A clip applier designed for use with asymmetric plastic clips in an open (i.e., non-endoscopic) surgical procedure is disclosed in U.S. Patent No. 5,100,416 to Oh et al., also assigned to the assignee of the presently disclosed subject matter.

In addition to compatibility with sophisticated diagnostic techniques, asymmetric clips have other advantages over symmetric clips. For example, because asymmetric clips are formed from polymeric materials, the mouths of asymmetric clips can generally be opened wider than the mouths of symmetric clips. This allows a surgeon to position the clip about the desired vessel with greater accuracy. In addition, a clip of the type described in the aforementioned U.S. Patent Nos. 4,834,096 and 5,062,846 can be repositioned before locking the clip on the vessel or before removing the clip from the vessel, in a process referred to as "approximating" the clip.

Various types of hemostatic and aneurysm asymmetric clips are used in surgery for ligating blood vessels or other tissues to stop the flow of blood. Such clips have also been used for interrupting or occluding ducts and vessels in particular surgeries such as sterilization procedures.

Applying the clip for occluding the vessel or other tissue might be the end desired result. Generally then, the clip is left in place after application to the tissue until hemostasis or occlusion occurs. At some point thereafter, the

clip can be removed by using a separate instrument dedicated for that purpose, i.e., a clip removal instrument.

However, in many procedures, a vessel is occluded so that it can be safely cut. In this type of procedure, generally a vessel is clamped on both sides of the desired cut site and then the vessel is severed between the two clips. The vessel can then be anastomosed at the cut ends, or to other vessels or tissue, as required by the particular procedure. After anastomosis, the clips can be removed to restore circulation through the tissue.

Whether the clip is metallic or polymeric, it is important to leave a small cuff of tissue, typically about 1.0-3.0 mm, between the cutting face of the clip and the cut site. Without a cuff, the clip might not properly stay attached or secured in place on the vessel. For instance, the tissue could retract after cutting and pull out of the clip. Also, if the clip is applied askew, an end could pull out, resulting in leakage from the cut vessel. Further, cutting too close to the clip risks the clip being accidentally nicked, which could result in failure of the clip.

Although physicians generally desire to leave tissue cuffs on the cutting face of clips, certain situations can make this difficult. For example, in surgical sites with limited space, such as in endoscopy, the cutting zone can be very narrow, thus resulting in the placement of the clips too close to one side or the other of the cut site. Also, instances where the physician desires to preserve as much vessel as possible on the uncut face of the clip, can result in placement of the clip too close to the cut site. Finally, in close or obstructed-view surgical sites, judging the proper distance to cut from the clip can be extremely difficult.

Although polymeric ligating clips are well known in the surgical area and improvements have been made to the ligating clips, none have heretofore been designed with a mechanism to aid the physician in cutting ligated tissue properly, so that a safe length of tissue cuff remains on the cutting face of the clip. Therefore, there is believed to be a long-felt need for an improved polymeric surgical ligating clip with such a mechanism, which is particularly well

suited for use in guiding a physician when cutting ligated tissue. The present disclosure is believed to provide such an improved surgical clip.

Summary

In accordance with the present disclosure, a polymeric surgical clip is provided of the type comprising first and second legs joined at their proximal ends by a flexible hinge section. Each leg has a vessel clamping inner surface, an opposite outer surface, and a pair of opposing side surfaces. The vessel clamping inner surface is in opposition to the vessel clamping inner surface of the other leg. At least one cutting guide is provided on one or more of the side surfaces for aiding the physician in properly cutting the ligated tissue. Further, a female locking member is positioned on the distal end of the first leg and a male locking member is positioned on the distal end of the second leg. The female and male locking members are formed such that when the first and second leg members are moved from an open position to a closed position about the hinge section, the male locking member is lockingly engaged in the female locking member so as to removably lock the clip in the closed position.

In the preferred embodiment, the clip has a plurality of cutting guides. Preferably, the first and second legs each have at least one cutting guide disposed thereon. More preferably, at least one cutting guide is disposed on each side surface of the first and second legs. The cutting guide extends outward from the side surface to a height of at least about 3.0 mm, but can also be shorter or longer as needed. The cutting guide can have an elongated shape, whereby the length of the cutting guide is greater than its width.

The surgical clip further comprises a pair of bosses joined to opposite sides of the first leg, between the hinge section and the distal end of the first leg. The preferred embodiment also comprises a second pair of bosses joined to opposite sides of the second leg at the distal end of the second leg. A sharp tissue-penetrating tooth extends from each of the second pair of bosses outwardly towards the distal end of the first leg.

Further in the preferred embodiment, the inner vessel-clamping surface of the first leg has a concave radius of curvature and the outer surface has a

convex radius of curvature between the hinge section and the distal end. In the same embodiment, the inner vessel-clamping surface of the second leg has a convex radius of curvature and the outer surface has a concave radius of curvature between the hinge section and the distal end. At least one of the inner surfaces of the clip comprises a plurality of protrusions extending from the inner surface, for providing improved vessel retention during and following closure of the clip. Preferably, both of the inner surfaces comprise the plurality of protrusions.

The surgical clip disclosed herein is most suitably made of polymeric material and accordingly minimizes interference with high technology diagnostic modalities such as CAT SCAN, MRI and MRS. At the same time, the clip is nearly as small as comparable metal clips while maintaining sufficient strength and possessing a high degree of security in the clip's latching mechanism. The surgical clip is further configured to provide a mechanism for guiding a physician through cutting of the clamped vessel so that a tissue cuff is created.

It is therefore an object of the presently disclosed surgical clip to provide a polymeric surgical clip capable of occluding a vessel and guiding a physician when cutting the vessel so that a tissue cuff of proper length is created.

It is a further object to provide a polymeric surgical clip for guiding a physician in cutting a vessel to produce a tissue cuff of proper length, wherein the clip comprises a cutting guide extending outward from and disposed along at least a portion of the length of one or both side surfaces of one or both of the first and second legs thereof.

Some of the objects of the subject matter disclosed herein having been stated hereinabove, other objects will become evident as the description proceeds when taken in connection with the accompanying drawings as best described hereinbelow.

Brief Description of the Drawings

Figure 1 is a perspective view of the improved surgical ligating clip of the present invention with a surgical cutting guide;

Figure 2 is a second perspective view of the surgical ligating clip;

Figure 3 is a third perspective view of the surgical ligating clip;

Figure 4 is a side elevation view of the surgical ligating clip showing the positioning of two cutting guides;

Figure 5 is an enlarged perspective view of the surgical ligating clip showing the hinge section and proximal ends of the first and second legs in detail including three cutting guides;

Figure 6A is a perspective view of a clip applier being inserted into a compartment of a clip cartridge to engage a surgical ligating clip provided in accordance with the present invention;

Figure 6B is another perspective view showing the clip applier engaging the surgical ligating clip loaded in one of the compartments of the clip cartridge as shown in Figure 6A; and

Figure 6C is another perspective view showing the clip applier extracting the surgical ligating clip from the compartment of the clip cartridge shown in Figure 6A.

Detailed Description

Referring first to Figures 1 - 5 of the drawings, one example is illustrated of an asymmetric surgical clip with a cutting guide, generally designated **12**, that is suitable for use in conjunction with the presently disclosed subject matter. Clip **12** and others of similar design are particularly useful as hemostatic clips that can be latched around a vessel or other type of tissue to ligate the vessel and thereby stop or reduce the flow of fluid through the vessel. Clip **12** can be constructed from any suitable biocompatible material, such as certain metals and polymers. However, the presently disclosed subject matter is particularly suitable for practice with polymeric clips. Thus, clip **12** preferably comprises a one-piece integral polymeric body formed from a suitable strong biocompatible engineering plastic such as the type commonly used for surgical implants. Examples include, but are not limited to, acetal polyoxymethylene (POM), polyethylene terephthalate (PET), polybutylene terephthalate (PBT), polyoxymethylene, or other thermoplastic materials having similar properties that can be injection-molded, extruded or otherwise processed into like articles.

Now turning to Figure 1, the body of clip **12** comprises a first or outer leg, generally designated **22**, and a second or inner leg, generally designated **24**. First and second legs **22** and **24** are joined at their proximal ends by an integral hinge section, generally designated **26**. First and second legs **22** and **24** each have a pair of opposing side surfaces **52** and **54**. First and second legs **22** and **24** also have complementary arcuate profiles. Thus, first leg **22** has a concave inner surface **28** and a convex outer surface **30**, and second leg **24** has a convex inner surface **32** and a concave outer surface **34**. Convex inner surface **32** of second leg **24** and concave inner surface **28** of first leg **22** have substantially matching radii of curvature.

Hinge section **26** has a continuous concave inner surface **36** and a continuous convex outer surface **38**. Concave inner surface **36** of hinge section **26** joins concave inner surface **28** of first leg **22** and convex inner surface **32** of second leg **24**. Convex outer surface **38** of hinge section **26** joins convex outer surface **30** of first leg **22** and concave outer surface **34** of second leg **24**.

First leg **22** terminates in a female locking member **40** at its distal end. Female locking member **40** comprises a resilient inwardly turned hook **41**. Second leg **24** terminates in a male locking member **50**. Male locking member **50** comprises a pointed tip section **42** at its distal end. Hook **41** is distally curved inwardly toward hinge section **26**, and has a transverse beveled surface **44**. Beveled surface **44** and concave inner surface **28** define a latching recess **46**, which is adapted for conformally engaging tip section **42** of male locking member **50** in the course of compressing clip **12** into a latched or locked position around a vessel or other tissue.

As best shown in Figure 2, the top surface of hook **41** preferably comprises two convex surfaces **47** that come together to define a sharp crest-like cutting edge **49** to facilitate cutting through connective tissue adjacent a vessel or other tissue during latching of the clip therearound.

As best shown in Figure 3, which is a view directed into the open concave side of clip **12**, clip **12** comprises opposing side surfaces **52** and **54**.

Typically, the body of clip **12** has a constant thickness between side surfaces **52** and **54**. Adjacent to the distal end of the first leg **22** and immediately inwardly of hook **41**, a pair of cylindrical bosses **56** and **58** are formed coaxially on the opposed side surfaces **52** and **54**, respectively, of first leg **22**. In the illustrated example of clip **12**, a bridge section **66** couples bosses **56** and **58** together. As evident in Figure 2, bosses **56** and **58** project outwardly beyond convex outer surface **30** of first leg **22**.

Referring again to Figure 3, at the distal end of second or inner leg **24**, another pair of cylindrical bosses **62** and **64** is formed coaxially on the opposed lateral surfaces of inner leg **24** at tip section **42**. As evident in Figure 3, bosses **62** and **64** of second leg **24** extend longitudinally forward beyond tip section **42**.

Also, as best shown in Figure 3, hook **41** of first leg **22** preferably terminates at a sharp tip **68** with cutting edge **49** extending at least along a portion of the length of the top surface of hook **41**. Male locking member **50** of second leg **24** includes a pair of inwardly directed sharp tissue-penetrating teeth **72** and **74**, to assist in gripping, stretching and piercing nearby connective tissue, in concert with cutting edge **49** and sharp tip **68** on hook **41**.

Both first and second legs **22** and **24** have a plurality of protrusions or teeth **76** extending from their respective inner surfaces **28** and **32**. These features are designed to engage the tissue of the vessel being clamped and assist in preventing the vessel from sliding laterally or longitudinally during or following clip closure. It will be noted, however, that other clips equally suitable for use in conjunction with the presently disclosed subject matter may not contain such features.

As best shown in Figure 5, clip **12** further comprises a plurality of integral cutting guides **80** extending outward from and disposed along at least a portion of both side surfaces **52** and both side surfaces **54**. Cutting guides **80** are designed to aid the physician in cutting the ligated vessel or tissue properly, such that a tissue cuff of safe length (typically about 1.0-3.0 mm) is produced. Cutting guides **80** have a height **H** of 3.0 mm or less extending out from side surfaces **52** and **54** of clip **12**. Height **H** varies depending on the desired size of

the cuff produced after the vessel is cut. As height **H** increases, so does the length of the tissue cuff, and vice versa with decreasing height **H**. Cutting guides **80** have a length **L** in the lengthwise direction of first and second legs **22** and **24** that varies according to need. One of skill in the art will appreciate different benefits to different lengths **L**, and the presently disclosed subject matter is intended to be inclusive of these variations based on design choice.

In a preferred embodiment, length **L** is sufficient to provide a stable guide against which the cutting implement can rest during the cut. It is envisioned that length **L** can be as great as the length of opposing side surface **52** or **54**, but no longer since otherwise it would interfere with the proper functioning of female and male locking members **40** and **50** and/or hinge section **26** (or even bosses **56**, **58**, **62** and **64**, if present). However, this is rarely desirable since it could decrease the flexibility of first and second legs **22** and **24**, which is necessary for optimal functioning of clip **12**. In the preferred embodiment shown in Figures 1-5, length **L** is half or less the length of lateral sides **52** and **54**.

In an alternative embodiment, length **L** can be much less than what is required for guiding the cutting implement if more than one cutting guide **80** is present in a spaced-apart relationship along the same lateral side **52** or **54**. In this embodiment, spaced apart cutting guides **80** work together as one cutting guide **80** to guide the cutting implement. This arrangement requires less material, thereby having less impact on the overall flexibility of clip **12**. It is envisioned that in an alternative embodiment, bosses **56**, **58**, **62** and **64** can have the same height as cutting guide **80**, and thereby also function in concert with cutting guide **80** as additional spaced-apart cutting guides **80**. However, it is noted that bosses **56**, **58**, **62** and **64** cannot alone function as cutting guides **80**, since they do not have a length great enough to provide a stable platform for guiding the cutting implement. Further, they cannot be lengthened enough to function as guides by themselves, since then they would not be able to function as bosses for a clip applying instrument **120**, as described in detail below and shown in Figures 6A-6C. Therefore, only in an embodiment where

bosses **56**, **58**, **60** or **62** have a height identical to height **H** of cutting guides **80** and are in a spaced-apart relationship on the same opposing sides **52** and **54** with cutting guides **80** can bosses **56**, **58**, **60** or **62** act in concert with cutting guides **80** as additional spaced-apart cutting guides **80**.

Cutting guides **80** have a width **W** that can be as great as the width of side surfaces **52** and **54**. A width **W** greater than the width of side surfaces **52** and **54** could interfere with clamping the vessel, and therefore is not desirable. In a preferred embodiment, width **W** is only as great as is needed to properly function as a guide to the cutting implement, e.g. such that cutting guides **80** will not collapse under the pressure of the cutting implement resting against it. A minimal width **W** is desirable so that the flexibility of first and second legs **22** and **24** is minimally impacted. In the illustrated preferred embodiment, width **W** is approximately half the width of side surfaces **52** and **54**.

Cutting guides **80** can be positioned anywhere along the length of side surfaces **52** and **54**. In the preferred embodiment, as best shown in Figure 4, cutting guides **80** are positioned adjacent, but not encroaching onto, hinge section **26**. This position is especially preferable if boss **56**, **58**, **62** or **64** can double as a 'surrogate' spaced-apart cutting guide **80**, as described above. Alternatively, one or more additional cutting guides **80** in spaced-apart arrangement can be positioned along the surface of the same side surfaces **52** and **54**.

The preferred embodiment of clip **12** has a cutting guide **80** on each of the four side surfaces **52** and **54**. In an alternative embodiment, Clip **12** can have only one (or more) cutting guide(s) **80** on just one side surface **52** or **54** of only one or both of legs **22** or **24**, if desirable, for a particular application. For example, a specialty clip **12** can be designed for a particular application where specific placement of clip **12** is imperative. In such a scenario, it could be preferable to have cutting guide **80** placed at a particular site, e.g. on only one side surface **52** or **54** of one or both first and second legs **22** and **24**, as a marker for the physician to properly position clip **12**, or as a reminder of where to cut after positioning. Alternatively, it may be desirable for clip **12** to have one

or more cutting guides **80** on each side surface **52** and **54** (as exemplified in Figures 1-5) so that the physician need not pay particular attention to the positioning of clip **12** or on which side of clip **12** the cut is made. Both embodiments and combinations thereof are envisioned by the present invention.

Clip Closure

In the practice of ligating and cutting a vessel or other tissue, as understood by persons skilled in the art, clip **12** is designed to be compressed into a latched or locked closed position around the vessel through the use of an appropriate clip applicator instrument, such as the type described in the aforementioned U.S. Patent No. 5,100,416. The clip applicator instrument engages bosses **56, 58, 62** and **64** of clip **12** and pivots bosses **56, 58, 62** and **64** inwardly about hinge section **26**. This causes first and second legs **22** and **24** to close around the vessel, with convex inner surface **32** of second leg **24** and complementary concave inner surface **28** of first leg **22** contacting the outer wall of the vessel.

However, before any contact is made between first and second legs **22** and **24**, sharp tissue penetrating teeth **72** and **74** on bosses **62** and **64** of second leg **24** start to indent and penetrate any connective tissue surrounding the vessel therebetween and pull the tissue down. Simultaneously, sharp tip **68** and hook **41** on first leg **22**, while sliding between teeth **72** and **74**, also begin to penetrate the tissue and force the tissue up. Sharp tip **68** and cutting edge **49** on hook **41** enter a groove **43** of pointed tip section **42** on second leg **24**, thereby beginning puncturing and cutting of the connective tissue.

As cutting edge **49** and sharp tip **68** of hook **41** continue to move through groove **43** between teeth **72** and **74**, shear forces contribute to further puncturing and cutting of the connective tissue surrounding the vessel. If all the tissue is still not cut between the distal portion of second leg **24** and hook **41**, it will stretch and become thinner until it is easily punctured by sharp tip **68** and cut by cutting edge **49** of hook **41** as it passes through groove **43** of

second leg **24**. Once the connective tissue is cut, female and male locking members **40** and **50** are able to lockingly engage without interference.

Tip section **42** of second leg **24** then begins to contact female locking member **40** at hook **41**. Further pivotal movement by the applicator instrument longitudinally elongates first leg **22** and deflects hook **41**, allowing tip section **42** of male locking member **50** to align with latching recess **46**. Upon release of the applicator instrument, tip section **42** snaps into and is conformably seated in latching recess **46**, at which point clip **12** is in its latched and closed position. In the latched condition, tip section **42** is engaged between concave inner surface **28** and beveled surface **44**, thereby securely clamping a designated vessel or other tissue between concave inner surface **28** and convex inner surface **32**.

After clip **12** is secured in its closed position and the vessel is ligated, most likely with two clips **12** on either side of the cutting site, the physician can safely cut the vessel. With prior art clips, as discussed hereinabove, the cutting step is potentially dangerous, as cutting too close to the clip can result in an unsafely short tissue cuff, no tissue cuff, or even nicking and damaging clip **12**. The presently disclosed clip **12** eliminates these dangers through incorporation of one or more cutting guides **80** on one or more side surfaces **52** and **54** of one or both legs **22** and **24**, as discussed herein above. In use, the physician simply abuts the cutting implement against the outer surface of cutting guides **80** and proceeds to sever the vessel with the braced cutting implement. The cutting implement is automatically aligned an optimal distance away from clip **12** so that a tissue cuff of proper size is produced.

Prior art clips similar to clip **12** are described in detail in the commonly assigned U.S. Patent No. 4,834,096 to Oh et al. and 5,062,846 to Oh et al., the disclosures of which are incorporated herein in their entireties. In addition, a particularly suitable clip is the HEM-O-LOK® clip commercially available from the assignee of the presently disclosed subject matter. These clips are currently available in sizes designated "M", "ML", "L" and "XL". The clip

cartridge described hereinbelow can be adapted to accommodate any sizes of HEM-O-LOK® clips commercially available.

Referring now to Figures 6A – 6C, a preferred embodiment of a clip cartridge, generally designated **100**, is shown for use with clip **12**. Clip cartridge **100** preferably is constructed from a single-molded plastic body from which several features are formed. In particular, clip cartridge **100** comprises a plurality of clip retaining chambers or compartments **111** spaced along a longitudinal axis **A** of clip cartridge **100**. Each clip compartment **111** is substantially identical and adapted for storing one clip **12**, which preferably has an asymmetric design with cutting guides **80**, **81**, **82** and **83** as described above and illustrated in Figures 1 - 5. Figure 6A illustrates one clip **12** in a stored condition in one of clip compartments **111**. It will be understood, however, that preferred embodiments of clip cartridge **100** include several clip compartments **111** for storing several clips **12**. For instance, clip cartridge **100** is adapted for storing six clips **12**, although other embodiments can be provided that store more or less clips **12**. If desired, an adhesive backing (not shown) can be provided on the underside of clip cartridge **100** to facilitate securing clip cartridge **100** to a tray or other supporting component during use.

Figures 6A – 6C also illustrate the distal end of a representative clip applying instrument for clip **12**, generally designated **120**, comprising opposing pivotable jaws **125A** and **125B**. Jaws **125A** and **125B** have respective jaw recesses **127A** and **127B** adapted to engage and retain bosses **56**, **58**, **62** and **64** of clip **12** (see Figures 1 - 5). According to a method provided herein, Figure 6A illustrates clip applying instrument **120** in a position over clip **12** prior to inserting clip applying instrument **120** into a selected clip compartment **111**. Figure 6B illustrates clip applying instrument **120** being inserted into selected clip compartment **111** to load clip **12** into locking engagement with clip applying instrument **120** (with bosses **56**, **58**, **62** and **64** retained in jaw recesses **127A** and **127B**). Figure 6C illustrates the subsequent step of extracting clip **12** from clip cartridge **100** by removing clip applying instrument **120** with clip **12** loaded therein.

It will be understood that various details of the presently disclosed subject matter can be changed without departing from the scope of the disclosure. Furthermore, the foregoing description is for the purpose of illustration only, and not for the purpose of limitation—the invention being defined by the claims.